CLAIMS

1. A communication system comprising: a transmission path for serving as a transmission medium of light; a first station having means for emitting time-divided optical pulses into the transmission path and measuring a phase difference between the optical pulses returning from the transmission path; and a second station having means for reversing traveling directions of the optical pulses, means for producing the phase difference, corresponding to a value of a random number bit to be transmitted, between the time-divided optical pulses, means for splitting each entering optical pulse into orthogonally polarized components and producing a 180-degree phase difference between the orthogonally polarized components, means for rotating each polarization direction by 90 degrees, and means for combining the orthogonally polarized components and reemitting the optical pulses into the transmission path.

2. The communication system according to Claim 1, wherein a phase modulator is used as the means for producing the phase difference, and by varying driving voltage to the phase modulator, the 180-degree phase difference is produced between the orthogonally polarized components.

3. The communication system according to Claim 1, wherein a single phase modulator is used as the means for producing the phase difference corresponding to the value of the

random number bit to be transmitted and the means for producing the 180-degree phase difference between the orthogonally polarized components, and by temporally varying driving voltage, the phase difference corresponding to the value of the random number bit and the 180-degree phase difference between the orthogonally polarized components are produced at the same time.

4. The communication system according to Claim 1, wherein after each entering optical pulse is split into orthogonally polarized components, the split polarized components are input to different terminals of a phase modulator, and the polarization directions thereof are rotated by 90 degrees after the phase difference is produced therebetween, and then the split polarized components are recombined.

5. The communication system according to Claim 4, wherein after each entering optical pulses is split into the orthogonally polarized components, distances along which the split polarized components propagate before entering the phase modulator are set to be different for each polarized component, and by temporally varying driving voltage, the phase difference corresponding to the value of the random number bit and the 180-degree phase difference between the orthogonally polarized components are produced at the same time.

6. The communication system according to Claim 4, wherein

after each entering optical pulses is split into the orthogonally polarized components, optical paths along which the split polarized components propagate before entering the different terminals of the phase modulator are composed of a polarization-maintaining optical fiber.

7. The communication system according to Claim 6, wherein by orienting a polarizing axis of the polarization-maintaining optical fiber along electric-field vectors of the orthogonally polarized components of the entering optical pulse, the split polarized components are combined with their polarization directions rotated by 90 degrees.

8. The communication system according to Claim 4, 5, or 6, wherein a Faraday rotator is used as the means for producing the 180-degree phase difference between the orthogonally polarized components and the means for rotating each polarization direction by 90 degrees.

9. The communication system according to Claim 1, wherein a polarization beam splitter is used as the means for splitting each of the optical pulses into the orthogonal components and the means for combining the orthogonal components, and antireflection termination is provided at a port, from which a polarized component resulting from a deviation from the polarization rotation angle of 90 degrees is output, of the polarization beam splitter.

10. The communication system according to any one of

Claims 1 to 9, wherein the second station has means for attenuating intensity of each optical pulse to include no more than 1 photon per bit when reemitting the optical pulses into the transmission path after combining the orthogonally polarized components, so that a quantum cryptographic key is distributed.

11. A communication method comprising the steps of: causing a first station to emit time-divided optical pulses into a transmission path and measure a phase difference between the optical pulses returning from the transmission path; and causing a second station to combine orthogonally polarized components of each optical pulse and reemit the optical pulses into the transmission path, wherein the second station has the transmission path for serving as a transmission medium of light, means for reversing a traveling direction of the optical pulses, means for producing the phase difference, corresponding to a value of a random number bit to be transmitted, between the time-divided optical pulses, means for splitting the entering optical pulse into the orthogonally polarized components and producing a 180-degree phase difference between the orthogonally polarized components, means for rotating polarization direction of each polarized component by 90 degrees.

12. The communication method according to Claim 11,

wherein a phase modulator is used as the means for producing the phase difference, and by varying driving voltage to the phase modulator, the 180-degree phase difference is produced between the orthogonally polarized components.

13. The communication method according to Claim 11, wherein a single phase modulator is used as the means for producing the phase difference corresponding to the value of the random number bit to be transmitted and the means for producing the 180-degree phase difference between the orthogonally polarized components, and by temporally varying driving voltage, the phase difference corresponding to the value of the random number bit and the 180-degree phase difference between the orthogonally polarized components are produced at the same time.

14. The communication method according to Claim 11, wherein after each entering optical pulse is split into orthogonally polarized components, the split polarized components are input to different terminals of a phase modulator, and the polarized directions thereof are rotated by 90 degrees after the phase difference is produced therebetween, and then the split polarized components are recombined.

15. The communication method according to Claim 14, wherein after each entering optical pulse is split into the orthogonally polarized components, distances along which the

split polarized components propagate before entering the phase modulator are set to be different for each polarized component, and by temporally varying driving voltage, the phase difference corresponding to the value of the random number bit and the 180-degree phase difference between the orthogonally polarized components are produced at the same time.

16. The communication method according to Claim 14, wherein after each entering optical pulse is split into the orthogonally polarized components, optical paths along which the split polarized components propagate before entering the different terminals of the phase modulator is composed of a polarization-maintaining optical fiber.

17. The communication method according to Claim 16, wherein by orienting a polarizing axis of the polarization-maintaining optical fiber along electric-field vectors of the orthogonally polarized components of the entering optical pulse, the split polarized components are combined with their polarization directions rotated by 90 degrees.

18. The communication method according to Claim 14, 15, or 16, wherein a Faraday rotator is used as the means for producing the 180-degree phase difference between the orthogonally polarized components and the means for rotating each polarization direction by 90 degrees.

19. The communication method according to Claim 11,

wherein a polarization beam splitter is used as the means for splitting each of the optical pulses into the orthogonal components and means for combining the orthogonal components, and antireflection termination is provided at a port, from which a polarized component resulting from a deviation from a polarization rotation angle of 90 degrees is output, of the polarization beam splitter.

20. The communication method according to any one of Claims 11 to 19, wherein the second station has means for attenuating intensity of each optical pulse to include no more than 1 photon per bit when reemitting the optical pulses into the transmission path after combining the orthogonally polarized components, so that a quantum cryptographic key is distributed.